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Contribution to the Description of Pupae of the Western Palearctic lymantriids (Lepidoptera, Lymantriidae)

J. PATOČKA & M. TURČANI

A b s t r a c t : Contribution to the Description of Pupae of the Western Palearctic lymantriids (Lepidoptera, Lymantriidae). The descriptions of pupae of nine Western Palearctic species of Lymantriidae (Lepidoptera, Noctidea), are listed in the paper. These ones represent 3 sub-families and tribes, and 5 genera. Except of descriptions, also the main morphological characters of pupae were drawn. The paper also completes and corrects previous descriptions according to new acquisitions. The systematic status and position of described species in current systems is discussed from the point of view of morphology of their pupae.

K e y w o r d s : Lepidoptera, Lymantriidae, pupae, comparative morphology, taxonomy.

Introduction

This paper continues the work published in PATOČKA (1991, 1992) and PATOČKA & TURČANI (2005). The lepidopteran pupa is the stage in which external morphology is not covered by hairs and/or scales and it is thus relatively easy to find many characters which may be used for identification but also classification (PATOČKA & TURČANI 2005). We here mainly describe species from southern and western part of western Palearctic, which have not been described in previous papers, or which were described incompletely, due to lack of material and/or publishing possibilities. The taxonomic position of some lymantriids is not completely clear and current system according to KARSHOLT & VAN NIEUKERKEN (2004) is still discussed. The main aim of this paper is to study external morphology of pupae and apply results in additional study of taxonomy position of taxa of family Lymantriidae. The identification key of the genera of family Lymantriidae in PATOČKA & TURČANI (2005) needed to be completed and also results of other papers cited above had to be corrected in some cases what is done in this paper. We also discuss suggestions or recommendations for taxonomists specific to lymantriids, who may choose to reject thes

e results in future taxonomy concepts of Lymantriidae.

Material and methods

Pupal material was loaned from: Royal Belgian Institute of Natural Sciences in Brussels, Museum of Natural History in Vienna and Zoological museum of University of Alexander von Humboldt in Berlin and originates from the collection of the senior author. The methodology used is the same as described in PATOČKA (1991, 1992) and PATOČKA & TURČÁNI (2005).

Results

Subfamily *Callitearinae*

Genus *Calliteara* BUTLER 1881

For identification of genus *Calliteara* in current concept (KARSHOLT & VAN NIEUKERKEN 2004, MAZZEI et al. 2007) using the key to the genera of family Lymantriidae in PATOČKA & TURČÁNI (2005) (at couplets 2-8) it is necessary to modify as follows:

- 2(1) Prothoracic coxae concealed.....*Ocneria* HÜBNER 1819
 - Distinct prothoracic coxae situated caudad of maxillae (figs 1, 33, 39, 59)3
- 3(2) Scales present on dorsum of basal segments of abdomen (figs 5, 6, 44, 47)4
 - Scales absent on dorsum of basal segments of abdomen (figs 18, 35, 54).....6
- 4(3) Antennae short, their ends separated from each other
 - er. Forewings join to each other (figs 39, 51), or ends of metathoracic legs join to prothoracic ones.....*Orgyia*
 - Antennae concealed by each other at the ends (male, fig. 1) or isolated from each other, medium long and rounded at the ends, or also short and pointed (female, fig. 2). Forewings isolated from each other, mesothoracic legs join to the ends of metathoracic legs (figs 1, 2).....5
- 5(4) Cremaster medium long, relatively narrow (figs 8-10). Labium slightly shorter than maxillae, which join to each other at the ends (figs 1, 2). Antennae of female short and pointed (fig. 2) *Calliteara* partially
 - Cremaster short and wide. Labium the same in length as maxillae. Antennae of female medium long and rounded at the ends.....*Laelia* STEPHENS 1828
- 6(3) Secondarily setae on pupa medium short in isolated groups (fig. 33).....*Euproctis*
 - Secondarily setae on pupa long (figs 1, 7, 59, 62).....7
- 7(6) Antennae extend beyond prothoracic coxae by far (figs 59, 60)8
 - Antennae approximately reach or slightly extend beyond prothoracic coxae (figs 11, 21, 22).....*Calliteara* partially
- 8(7) Cremaster narrower and medium long, longitudinally finely furrowed (figs 67-69). Secondarily setae present on oculi (figs 59, 60)*Parocneria*
 - Cremaster shorter, wider and without furrowing. Oculi without secondarily setae*Gynaephora* HÜBNER 1822

Pupae of western Palaearctic species of genus *Calliteara* (according current concept) are characterised by following characters: Body rounded anteriorly, bigger and stouter on female than male (figs 1, 2, 11, 21, 22). Coloration black to light brown, glossy, sculpture rather fine. Oculi, genae and ventral side of thorax without secondarily setae (figs 1,

11, 22). Secondly setae cover on notum and on dorsum of abdomen long and more-less dense (figs 5, 18, 31), shorter on ventral side of abdomen (figs 1, 11, 22). Scales on dorsum of abdominal segments 1-3 present only on species *C. fortunata* (figs 5, 6). Dorsum of basal segments of abdomen of *C. abietis* and *C. pudibunda* with onion-like enlarged setae on the base (figs 13, 25). Labrum wide, trapezium-like at majority and often concave on caudal side (figs 3, 17, 23). Labium present, medium big and wide, tapering to the end. Maxillae slightly longer than labium, their ends rounded and join to each other (figs 1, 2, 11, 21, 22). Prothoracic coxae visible, the same in length or longer than maxillae, tapering and pointed. Protho- and mesothoracic legs join to each other, mesothoracic ones join to forward narrowed and relatively long ends of metathoracic legs, thus forewings are separated from each other (figs 1, 2, 11, 21, 22). Antennae relatively short, separated far from each other and pointed (figs 2, 11, 21, 22), only male of *D. fortunata* with antennae concealed by each other at the ends, these ones wider and rounded there (fig. 1). Abdominal spiracles elliptical dark with lighter frames (figs 7, 14, 26). Cremaster medium long to long, often wider on the base, however relatively narrow at least on endal part, pointly rounded at the end. End with numerous group (brush) of medium long fixing hooks (figs 8-10, 15, 19-20, 27-28, 32) and its sides and dorsum often with secondarily setae (figs 15, 19-20, 27-28, 32).

Genus *Calliteara* in current concepts (KARSHOLT & VAN NIEUKERKEN 2004, MAZZEI et al. 2007) has in western Palaearctic fauna four species, pupae of which it is possible to identify as follows:

- 1 Centres of dorsum of abdominal segments 1-3 with a group of white scales in the shape of rhomb (figs 5, 6)..... *C. fortunata*
- Centres of dorsum of basal abdominal segments without groups of scales (figs 18, 31).....2
- 2(1) Prothoracic legs join to each other at least at $4 \times$ longer distance than mesothoracic legs. Notum and dorsum of abdomen with very dense and long erected secondarily setae *C. fascelina*
- Prothoracic legs join to each other at most if $2 \times$ longer distance than mesothoracic legs (figs 11, 21-22). Notum and dorsum of abdomen with less dense, long and fine setae. Setae on basal abdominal segments onion-like enlarged on the base (figs 13, 18, 25, 31).....3
- 3(2) Secondly setae on basal abdominal segments onion-like enlarged on the base and white in colour there, contrasting with black vicinity (figs 13, 18). Abdominal spiracles with white frames (fig. 14). Pupa black, exuvia black-brown to black, strongly glossy. Movable abdominal segments opaque in frontal part (fig. 14). *C. abietis*
- Secondly setae on basal abdominal segments with brown or black base, the same as vicinity (figs 25, 31). Abdominal spiracles with yellow-brown frames. Pupa black brown to brown, exuvia brighter, glossy. Also movable abdominal segments with glossy frontal part (fig. 26)..... *C. pudibunda*

***Calliteara fortunata* (ROGENHOFFER 1891) (figs 1-10)**

Material examined: 4♂♂, 2♀♀ from the Canary Islands.

Pupae: 18-25 × 7-9 mm, glossy black brown to black, exuvia brighter, glossy. Labrum, labium, base of antennae and ends of central abdominal segments brighter, ochre or reddish brown. Sculpture fine, without indicated venation on forewings. Secondly setae long, bright straw yellow. Labrum slightly tapering, trapezium like, cut out on caudal side. Labium enlarged in centre and pointed. Prothoracic coxae adjacent to each

other more-less at shorter distance than prothoracic legs, these ones adjacent to each other at distance $2.5-3.5 \times$ longer than mesothoracic legs, which join ends of metathoracic legs. Antennae of male concealed by each other behind the ends of prothoracic coxae and these ones rounded at the ends. Antennae of female pointed and conspicuously extend beyond the ends of prothoracic coxae. Thoracic spiracle in shape of wide slit and field separated by wrinkles with different sculpture present behind it. Metanotum shallow arch-like cut-out, its frontal projections short and widely rounded. Visible ends of metathoracic legs do not extend beyond caudal margin of abdominal segment 3. Centres of abdominal segment 1-3 with groups of white almost circle scales on tangs in shape of rhomb. Abdominal spiracles are dark brown with bright brown frames. Cremaster relatively slender, ventrally and dorsally tapering immediately from the base and then with non-tapering sides, pointly rounded at the end. Secondarily setae – hooks are in group only at its end. Surface of cremaster smooth.

Cocoon of pupa is overground, soft, bright grey, mixed with secondarily setae of larva. Larva feeds on *Pinus canariensis*. *C. fortunata* occurs only at Canary Islands.

***Calliteara fascelina* (LINNAEUS 1758)**

This species is described and figured in PATOČKA (1991) and PATOČKA & TURČÁNI (2005) where it is classified in separate genus *Dicallomera* BUTLER 1881. Its separation from other western Palearctic species of genus *Calliteara* is listed in identification key of this genus in papers mentioned above.

***Calliteara abietis* (DENIS & SCHIFFERMÜLLER 1775) (figs 11-15, 16-20)**

After examination of more extensive material, we complete and correct information about this species which was described in PATOČKA (1991) and PATOČKA & TURČÁNI (2005):

Material examined: 3♂♂, 2♀♀ from the Czech Republic.

Pupa of male: 17-20 × 4.9-6.1 mm, female 23-25 × 7.3-7.5 mm. Pupa of female bigger and stouter, else morphologically similar to that of male. Pupa black to black brown, locally brighter (e.g. on caudal movable abdominal segments), strongly shiny. Base of movable abdominal segments opaque black however. Sculpture fine in majority. Forewings with fine longitudinal furrows on position of venation. Secondarily setae bright straw yellow, base of setae in central part of basal abdominal segments onion-like enlarged and white in colour which contrast with black colour of segment itself. Cremaster with secondarily setae, similar like in *C. pudibunda*. Labrum with more tapering sides as those in *C. pudibunda* and with caudal side shallow and wide cut out. Labium with domed sides. Maxillae serrate on border with labium, they join to each other at short distance on ends. Prothoracic coxae visible, wedge-like and relatively long, join to each other at $2 \times$ longer distance than prothoracic

legs, prothoracic legs join to each other only slightly longer than mesothoracic legs, which join ends of metathoracic legs. Metanotum slightly deeper and rather cut out roundly in salient angle and its frontal projections slightly more pointed than those of *C. fortunata* and *C. pudibunda*. Visible part of hindwings exceeds caudal margin of abdominal segment 3. Abdominal spiracles elliptical, their frames white in colour. Anal field elevated. Cremaster medium long and slender, tapering and rounded pointly at the

end. This one obliquely cut and pointed at the end in lateral view, and slightly longitudinally wrinkled at the end in ventral view. Its end with group (brush) of almost black hooks.

***Calliteara pudibunda* (LINNAEUS 1758) (figs 21-28, 31-32)**

After examination of more extensive material, we complete and correct information in PATOČKA (1991) and PATOČKA & TURČÁNI (2005):

Material examined: 5♂♂, 5♀♀ from Slovakia.

Pupa of male: 17-21 × 5.8-6.2 mm, female: 24-27 × 7.2-7.7 mm. Pupa of female more stout with slightly shorter antennae, else similar to that of male. Coloration of pupa brown to black-brown, exuvia brighter, glossy, movable abdominal segments glossy also in basal part. Sculpture fine at majority, secondarily setae bright straw yellow and onion-like enlarged and dark (as vicinity) at the base on dorsum of basal abdominal segments. Labrum with slightly tapering and domed sides, this one cut out at caudal side. Labium with more domed sides and slightly more obtuse than that of *C. fortunata*. Prothoracic coxae visible, these ones tapering and pointed as those in *C. fortunata*, but longer, thus join to each other at longer distance than prothoracic legs. Mesothoracic legs join to each other at almost the same distance as prothoracic legs and touch to metathoracic legs. Antennae of male and female short, pointed, separated far of each other, their ends extend to the level of ends of prothoracic coxae, slightly shorter on female. Venation of forewings conspicuously indicated like fine longitudinal furrows. Thoracic spiracle in shape of wide slit. Metanotum medium shallow arch-like cut out, its frontal projections wide and obtusely round. Visible part of hindwings extends far beyond caudal margin of abdominal segment 3. Abdominal spiracles elliptical, dark brown with brown yellow frames. Cremaster medium in length, tapering and pointly rounded at the end. This one with fine longitudinally furrows prior end in ventral view, with secondarily setae on sides and dorsal side, and with brush of dark-brown hooks at the end.

Subfamily Nygmidae

Genus *Euproctis* HÜBNER 1819

Genus *Euproctis* is described in PATOČKA (1991) and it is possible to identify it using the key to genera of family Lymantriidae in PATOČKA & TURČÁNI (2005) or using the modified key of genera, listed in this paper (at genus *Calliteara*). Here described species *E. melania* differs from central European species (*E. chrysorrhoea* (LINNAEUS 1758) and *E. similis* (FUESSLY 1775) by long antennae of male (fig. 33), longer prothoracic coxae (figs 33, 63) and by cremaster, which is short and wide, obtuse and concave on caudal end (figs 36-38).

***Euproctis melania* (STAUDINGER 1891) (figs 29-30, 33-38, 63)**

Material examined: 4♂♂, 2♀♀ from Turkey.

Pupa : 12-15 × 4.3-5 mm, brown, exuvia brighter, ochre brown. Caudal part of movable abdominal segments ochre yellow. Sculpture medium fine, wrinkly, smooth locally.

Secondarily setae relatively short and yellowish concentrated in isolated groups on position of larval verrucae. Hooks on cremaster dark brown and relatively short. Postclypeus with individual setae. Labrum trapezium like, little tapering, its caudal side straight. Labium with domed sides and pointed. Maxillae extend beyond labium and join to each other at the ends. Prothoracic coxae longer than maxillae at least by half. Prothoracic legs join to each other at about $2 \times$ shorter distance than prothoracic coxae. Ends of mesothoracic legs join to ends of metathoracic legs, these ones tapering anteriorly. Antennae of male wide and long, widely rounded at the end, concealing majority of mesothoracic legs and extending beyond them, not joining to each other. Antennae of female slightly shorter, narrower and pointed, less concealing mesothoracic legs (fig. 63). Oculi not concealed at majority, without setae, also genae without setae. Thoracic spiracle narrow slit-like. Metanotum shallowly round cut out in obtuse angle, its frontal projections rounded, ends of visible hindwings conspicuously extend beyond caudal margin of abdominal segment 3. Abdominal spiracles narrow elliptical. Cremaster short and wide, narrower and obtusely wedge-like in lateral view, obtuse and more-less concave in ventral and dorsal view, without more conspicuous sculpture. Hooks on it numerous, forming relatively short brush.

E. melania occurs in Asia Minor.

Subfamily **O r g y i n a e**

Genus **Orgyia** OCHSENHEIMER 1810

Description of the genus is in PATOČKA (1991). Genus *Orgyia* it is possible to identify using the key to the genera of family Lymantriidae in PATOČKA & TURČÁNI (2005) or using the modified key listed here at genus *Calliteara*. After including three now described pupae of Mediterranean, east European and Asian Minor species, it is necessary to modify the key to the species of genus *Orgyia* in PATOČKA & TURČÁNI (2005) as follows:

- 1 Dorsal scales on abdominal segments 1-4 or 1-3 circled (fig. 47).....2
- Dorsal scales on abdominal segments 1-4 or 1-3 elongated, or bulbous (fig. 75).....4
- 2(1) Labium narrow, much narrower and also shorter than lobes of maxillae. Prothoracic coxae not longer or slightly longer than maxillae. Groups of scales present on abdominal segments 1-3 *O. recens*
- Labium wide, the same in width or wider than maxillae. Prothoracic coxae respectively coxae + femora conspicuously longer than maxillae (figs 39, 51). Groups of scales present on abdominal segments 1-4 (figs 44, 54).....3
- 3(2) Labrum transversally cut or concave at the end. Maxillae rounded at the end (fig. 52). Mesothoracic coxae concealed. Ends of female antennae separated from each other (fig. 51). Cremaster wide on base and strongly tapering ventrally (figs 56-58) ...*O. dubia*
- Labrum round at the end (fig. 40). Maxillae with projection at the end (fig. 41). Also mesothoracic coxae visible. Ends of male antennae close to each other (fig. 39). Cremaster narrower on base and less tapering ventrally (figs 48-50)..... *O. trigotephras*
- 4(1) Antennae barely exceed ends of prothoracic coxae. Maxillae relatively narrow at the end. Cremaster obtuse at the end. Groups of scales present on abdominal segments 1-3*O. antiqua*

- Antennae far exceed ends of prothoracic coxae. Maxillae narrow at the end. Groups of scales present on abdominal segments 1-3. Cremaster slender and tapering to the end *O. antiquoides*
 - Antennae barely exceed ends of prothoracic coxae (fig. 72), maxillae strongly clubbed to the end (figs 72, 73). Groups of scales present on abdominal segments 1-4 *O. aurolimbata*
- Orgyia recens* (HÜBNER 1819), *O. antiqua* (LINNAEUS 1758) and *O. antiquoides* (HÜBNER 1822) are elaborated in PATOČKA (1991) and PATOČKA & TURČANI (1952). Here we describe additional western Palearctic species of genus *Orgyia*:

***Orgyia aurolimbata* (QUENÉE 1835) (figs 72-80)**

Material examined: 1♂ from France, museum Brussels.

Pupa: 12.3 × 4.0 mm, spindle-like, rounded anteriorly, strongly tapering and pointed caudad. Coloration rust brown, exuvia brighter, locally rust brown yellow. Fuzzy dark brown patterns e.g. on front and clypeus, on sides of labrum, near oculus, between venation of forewings, on legs, on notum, around spiracles, on verrucae and on subventral area of abdomen with setae. Sculpture fine at majority. Secondarily setae, especially numerous on notum and dorsum of abdomen fine, long bright yellow. Dorsum of abdominal segments 1-4 with groups of whitish scales in shape of club. Abdominal spiracles narrow with robust black frames and rims. Ventral part of head without setae. Labrum little tapering, rounded on corners and cut out caudad. Labium approximately 2 × longer than labrum, this one barely extend beyond maxillae. These ones very clubbed and rounded to the end. Prothoracic coxae long, at the beginning with parallel margins, than tapering and pointed, these ones slightly shorter than antennae. Prothoracic legs relatively narrow and join to each other at short distance. These ones reach ends of antennae. Mesothoracic legs rather wide, pointed to the end and join to each other rather long distance, this one shorter than on prothoracic coxae. Wide and round at the end antennae not to come close to each other. Forewings join to each other at longer distance, these ones pointed and their external margin concave. Forewings with conspicuous ribbing. Metathoracic legs concealed on examined pupa. Metanotum medium deep and roundly cut out, its frontal projections also rounded. Anal field narrow, irregular, steeply merges base of cremaster. Cremaster long, slender conical, rounded at the end, this one with fine sculpture. Only its base with individual tiny setae and its end with brush of scale-like, bent, narrow and pointed bright setae.

Larva feeds polyphagously on shrub-like growing broadleaf trees and also on herbs. *O. aurolimbata* occurs in France and Iberian peninsula.

***Orgyia trigotephra* BOISDUVAL 1828 (figs 39-45, 47-50)**

Material examined: 1♂, 1♀ (incomplete) from Turkey.

Pupa: 9.5 × 3.0 mm (male) 15 × 6.0 mm (female), stout and rounded anteriorly and strongly tapering caudad and pointed. Coloration brown, exuvia brighter, glossy. Sculpture fine at majority. Setae on notum and abdomen fine, long yellowish, not present on head. Central part of abdominal segments 1-4 with white scales on tangs, these ones circle-like in view from above. These scales more-less separated to two groups in centre of dorsum. Cremaster with individual secondarily setae and group (brush) of brown and medium in length setae in shape of hook. Labrum round at the end, semicircle. Labium

wide almost as labrum and approximately $2 \times$ longer. Maxillae with short and separated pointed lobe at end. These ones the same in width as labial palpi and shorter than labium including palpi. Prothoracic coxae at least $3 \times$ longer than labium, with wider base and narrower projections on male. These ones (coxae + femora) slightly cut out on base in centre. Behind them, visible also much smaller and pointed mesothoracic coxae. Antennae of male medium in length, round at the end and tapering, but separated from each other by prothoracic legs, which extend beyond them conspicuously. Not concealed ends of mesothoracic legs extend beyond them conspicuously, but not reach to not concealed ends (relatively long and frontad narrowed) of metathoracic legs. Forewings join to each other shortly. Antennae of female conspicuously shorter than antennae of male, pupa of female bigger and stouter, shells of extremities and appendages missed on examined pupa. Visible part of oculus relatively big. Thoracic spiracle big, slit-like, darkly bordered. Sculptured field bordered by wrinkle present behind it. Metanotum medium deep, pointly round cut-out, its frontal projections round. Not concealed ends of hindwings extend far beyond caudal margin of abdominal segment 3 and these ones visible also on ventral side of pupa. Abdominal spiracles narrow elliptical, dark brown and brightly flanged. Anal field big, elevated, transition from it to the base of cremaster very steep. Cremaster differentiated, long and slender, slightly tapering and slightly round at the end without distinctive sculpture. The end of its dorsal side skewed in lateral view.

Larva feeds polyphagously, mainly on broadleaved trees like *Quercus*, *Cistus*, *Coriaria* spp. This species occurs in western Mediterranean (from Italy to west, and also in north-western Africa) and in Asia Minor.

***Orgyia dubia* (TAUSCHER 1806) (figs 46, 51-58)**

Material examined: 10♂♂ from Turkey 1♂ from France, museum Brussels.

Pupae: 9.5-11.5 \times 4.0-4.5 mm, brown to black brown, exuvia brighter ochre brown, glossy, vicinity of spiracles on basal abdominal segments brighter. Sculpture fine at majority, wrinkled locally. Setae on notum and abdomen long, fine, yellowish, undulated close to the ends. Cremaster with richer group of setae than that of *O. trigotephras*. End of cremaster with rich brush of dense bright brown hooks. Centrum of dorsum of abdominal segments 1-4 with white circle scales on tangs in dorsal view, these ones more-less separated to two groups on each segment. Labrum trapezium-like, its caudal side more-less concave. Labium wide and round caudad, not longer than labrum. Maxillae shorter than labium, rounded caudad, without projection. Prothoracic coxae big, at the beginning slightly, prior half of length strongly tapering and pointed. Prothoracic legs extend beyond them rather shortly. Coxae of mesothoracic legs concealed. Large portion of mesothoracic legs visible, these ones conspicuously separated from ends of metathoracic legs, thus forewings join to each other at relatively long distance. Ends of metathoracic legs tapering anteriorly and pointed. Antennae medium short, not tapering and their ends pointed. Thoracic spiracles relatively big, in shape of slit and dark framed, lobes of metanotum more pointed than that of *O. trigotephras*, hindwings similar to wings of this species. Abdominal spiracles rather of spindle-like shape, dark. Anal field large and strongly elevated, transition from it to the base of cremaster very steep. Cremaster medium in length and well differentiated, wide on base, tapering, rounded at the end (narrower and more pointly wedge-like in lateral view), without distinctive sculpture.

Larva feeds polyphagously on shrubs and semi-shrubs (Fabaceae, Rosaceae): This species occurs in southern and southeastern Europe, northern Africa and Asia Minor.

Genus *Laelia* STEPHENS 1828

Pupae of genus *Laelia* are described in PATOČKA (1992) according male only. This genus it is possible to identify using the key in PATOČKA & TURČÁNI (2005) and male and female are figured there and briefly described.

Pupae medium in size, medium to conspicuously stout, rounded anteriorly, more strongly tapering shortly prior the end caudad. Postclypeus with secondarily setae (fig. 81), these ones else missing on head. Dorsum of abdominal segments 1-3 with group of bright clubbed scales (fig. 82), which are less developed on female. Secondarily setae conspicuous. Labium and maxillae relatively long and rather narrow. Prothoracic coxae only medium in length, the most if slightly longer than labium and maxillae. Antennae of male longer and conceal each of other, these ones shorter and separated from each other on female. Prothoracic legs long, these ones reach almost to the end of mesothoracic legs, which join to each other only shortly. Forewing separated from each other. Mesothoracic legs join to ends of metathoracic legs, these ones relatively long. Anal field large and it merges base of cremaster steeply. Cremaster short, wide on base, slightly flattened, tapering and round or obtuse at the end (figs 83, 84).

Only one species of this genus occurs in Europe.

***Laelia coenosa* (HÜBNER 1808) (figs 81-84)**

Here, we list more precise description and figure some more detailed characters of this species as addendum to papers PATOČKA (1992) and PATOČKA & TURČÁNI (2005).

Material examined: 1♂ museum Vienna, 1♀ museum Berlin.

P u p a of male: 16.5 × 5 mm, female 17 × 6.6 mm. This one medium stout on male and stout on female, rounded anteriorly, prior end more strongly tapering caudad, brown, dark brown on male, exuvia brighter. Movable segments brighter, ochre on caudal part. Sculpture fine, locally scabrous, wrinkled mainly on notum on position of verruca with secondarily setae. Abdominal segments 1-3 with groups of bright clubbed scales in the centre of dorsum, these ones less developed on female. Secondarily setae long, yellowish, present also on postclypeus. Postclypeus of male tubercle-like elevated, labrum round at the end, labrum of female cut-out caudad. Mandibles rather differentiated on male mainly. Labium and maxillae approximately the same in length and these ones conspicuously long, medium narrow. Maxillae of male rounded at the end, slightly more pointed on female. Prothoracic coxae wedge like and rather shorter on male, these ones slightly longer than maxillae on female. Antennae of male wider, round at the end, reaching to approximately of $\frac{3}{4}$ of forewings length and their ends conceal by each other. Antennae extend far beyond prothoracic coxae. Antennae of female shorter, narrower and reach to approximately half of forewings, these ones separated from each other, their ends not conceal by each other. Prothoracic legs reach to almost ends of mesothoracic legs, these ones join to each other shortly (on female slightly longer). Mesothoracic legs join to (especially on female) long ends of metathoracic legs. Thoracic spiracle slit-like. Metanotum medium deep and rather roundly cut out in obtuse angle, its frontal projections rounded. Anal field large, steeply merges to the base of cremaster. Cremaster of

male the same in length, this one of female shorter than wide on base, slightly flattened and tapering dorsoventrally, rounded at the end on male, obtuse on female. Cremaster with secondarily setae on sides and with group of slender fixing hooks at the end. Its surface without more conspicuous sculpture.

Genus *Parocneria* DYAR 1897

Pupa of this genus is described in PATOČKA (1991) and it is possible to identify it using the key to genera of family Lymantriidae in PATOČKA & TURČÁNI (2005) or using the modified key listed here (on genus *Calliteara*).

Key to species identification:

- 1 Labrum on caudal side straight (figs 64-65). Antennae of male join prothoracic legs up to approximately 2/3 of their length, only endal part of mesothoracic legs remain unconcealed. Labium of male reaches approximately up to 1/2 of maxillae length (fig. 59). Labium of female reaches barely 1/4 of maxillae length and their palpi are very short (figs 60, 65). Mesothoracic legs of female join to each other at 2 × longer distance than metathoracic legs (fig. 60) *P. terebinthi*
- Labrum cut out on caudal side (figs 70-71). Antennae of male join prothoracic legs only at short distance, thus central part of mesothoracic legs remain unconcealed. Labium of female longer than half of maxillae and labial palpi longer than labium itself (fig. 71). Mesothoracic legs of female join to each other at short distance, which is not longer than border of metathoracic legs *P. detrita*

***Parocneria detrita* (ESPER 1785)**

This species is described in PATOČKA (1991) and PATOČKA & TURČÁNI (2005). We list additional western Palearctic species:

***Parocneria terebinthi* (FREYER 1838) (figs 59-62, 64-69)**

Material examined: 5♂♂, 5♀♀, Turkey.

P u p a of male: 13-15 × 3.5-3.9 mm, female: 17-23 × 5.1-6.0 mm. Male darker brown than female. Pupa with yellowish patterns (labrum, dorsal part of oculi, vicinity of groups of secondarily setae) on dark background. Caudal margins of abdominal segments 1-3 yellow, segments 4-6 red-grey. Sculpture fine at majority. Numerous and long secondarily setae, straw-yellow and grouped to brushes present on position of verrucae of larva. Secondarily setae present also on postclypeus, genae and oculi. Labrum trapezium-like, not cut out on caudal side. Labium of male slender, reaches approximately to 1/2 of maxillae length and its palpi not shortened. Maxillae palpi short, round at the end, between them incision, but they shortly join to each other. Prothoracic coxae shorter than maxillae. Antennae of male relatively long and pointed. These ones join prothoracic legs to approximately 2/3 of their length and conceal majority of mesothoracic legs. These ones join to each other at least 2 × longer distance than metathoracic legs, which touch to. Labium of female short and wide, its palpi very small. Maxillae of female longer, at least 4 × exceed the length of labium, they join to each other at long distance and are round at the ends and barely cut out. Prothoracic coxae of female shorter than maxillae and relatively narrow. Antennae join prothoracic legs at shorter distance, thus also cen-

tral part of mesothoracic legs not concealed. These ones shorter than on male and also pointed. Mesothoracic legs join to each other approximately $2 \times$ longer than ends of metathoracic legs, which touch to. Thoracic spiracle in shape of slit, with elliptical black and finely tomentose spot flanged by brighter area behind it. Metanotum medium deeply and roundly cut out in salient angle. Not concealed part of hindwings extend beyond caudal margin of abdominal segment 3. Abdominal spiracles elliptical and dark. Transition from anal field to the base of cremaster short and steep. Cremaster well differentiated, medium in length and narrow. Dorsal and ventral more, laterally less tapering, obtuse at the end. Dorsal side of cremaster skewed prior the end and cremaster relatively pointed in lateral view. This one with secondarily setae and with rust brown brush of hooks at the end.

Larva feeds on *Pistacia terebinthus*. *P. terebinthi* occurs on Balkan Peninsula, Asia Minor and Transcaucasia.

Discussion

KOZHANTSCHIKOFF (1950) named family Lymantriidae as Orgyidae and classified it as representatives of present subfamily Acronictinae behind Pantheinae (this one is considered to independent family sometimes) from family Noctuidae. Classification of subfamily Acronictinae to family Lymantriidae is completely wrong from the point of pupal morphology, but representatives of subfamily Pantheinae are more similar to taxa from family Lymantriidae and probably form some kind of transition between families Noctuidae and Lymantriidae.

If we compare present system of family Lymantriidae - according KARSHOLT & VAN NIEUKERKEN (2004) or MAZZEI et al. (2007) with results of our examination of pupal morphology of western Palaearctic representatives of this family in PATOČKA (1991, 1992), PATOČKA & TURČÁNI (2005) and in this paper, we can conclude the following:

Formation of subfamily Arctorninae agrees with our results. This one is group with concealed maxillary palpi and also prothoracic coxae and with very long slender cremaster, with fixing hooks also on sides of cremaster. Two genera (*Arctornis* GERMAR 1810 and *Leucoma* HÜBNER 1822) belong to this subfamily in western Palaearctic. According to pupal characters, the position of subfamily Lymantriinae is in its vicinity. Lymantriinae differs from subfamily Arctorninae mainly by abundant presence of secondarily setae on head (e.g. on oculi and genae) and by robust and only medium in length cremaster, which has fixing hooks at its end only. Only genus *Lymantria* HÜBNER 1819 belongs to this subfamily in western Palaearctic.

Pupa of genus *Penthophera* GERMAR 1812 is rather morphologically similar to these subfamilies. In taxonomy concepts mentioned above it is classified in subfamily Orgyinae. This one differs from Orgyinae by concealed labial palpi also with prothoracic coxae. It also differs from subfamilies Arctorninae and Lymantriinae however by e.g. long and wide antennae and obtusely conical shape of cremaster, from subfamily Lymantriinae also by absence of secondarily setae on genae and oculi. From the point of pupal morphology it would be more suitable to classify all these taxa to unified subfamily Lymantriinae with three tribes: Arctornini, Lymantriini and Penthoperini, or to form separate subfamily also for genus *Penthophera*.

Additional subfamilies classified in mentioned taxonomy systems: Callitearinae, Nygmiiinae and Orgyinae do not differ by the morphology of pupa conspicuously. From this point of view, they may form second subfamily of family Lymantriidae – Orgyinae. They all have unconcealed labium and except of genus *Ocneria* HÜBNER 1819 also prothoracic coxae.

One group of species is characterised by areas covered by scales in the centre of some of basal abdominal segments. These ones are species of genera *Orgyia* and *Laelia* from present subfamily Orgyinae and species *Calliteara fortunata* from subfamily Callitearinae. Other western Palaearctic species of genus *Calliteara* miss these structures. The groups of scales do not occur on the same segments on all listed taxa. Genus *Orgyia* have them on either segments 1-4 (*O. aurolimbata*, *O. trigotephras*, *O. dubia*), or only on segments 1-3 (*O. recens*, *O. antiqua*, *O. antiquoides*), whereas species *O. aurolimbata*, *O. antiqua* and *O. antiquoides* have these scales club-like, they are circled on other species. Genus *Laelia* have scales on segments 1-3 and these ones are more reduced on females. On species *Calliteara fortunata*, these ones are circled and occur on segments 1-3. Species *Calliteara fortunata* is similar to other western Palaearctic species of genus *Calliteara* by all other characters except of antennae of male.

Scale structures are rather unique on the pupae of lepidoptera. These ones were formed probably by transformation of secondarily setae. Genus *Calliteara* (on species *C. abietis* and *C. pudibunda*) has setae enlarged on the base on basal abdominal segments. These ones probably represent transition to scale structures, which were fully developed only on *C. fortunata* in this genus (from western Palaearctic species which we examined). It is possible to flag them as specialised characters (as are probably also concealed maxillae and prothoracic femora on subfamilies Arctorninae and Lymantrinae and on genus *Penthopera*).

Antennae on males of family Lymantriidae are generally bigger and longer as on females. All species are characterised by short life span, they do not take food by their rudiment proboscis (proboscis, or maxillae of pupae are thus always short) and male uses strongly developed and wide antennae to fast identification of female which produces pheromone. In spite of this, there are genera in this group with long (males of genera *Ocneria*, *Laelia*) and vice versa with short antennae (as on genera *Orgyia* whether *Calliteara*). In genus *Euproctis* occur short and narrower (*E. chrysorrhoea*) but also long and wide antennae (male of *E. melania*).

Genus *Ocneria* differs from all additional taxa of this group by concealed prothoracic coxae and has numerous secondarily setae on head. Cremaster is rather robust and longitudinally wrinkled (both these characters show to some similarity with genus *Lymantria*). Male has long, female shorter antennae.

Genus *Parocneria* DYAR 1897 has majority of characters (including secondarily setae on genae and oculi and furrowed cremaster) similar to genus *Ocneria*, it has unconcealed prothoracic coxae and different shape of antennae.

From the point of pupal morphology, would be both of these genera, which differs from subsequent also by habit and by morphology of larva, classified to separate tribe (Ocneriini), which would be positioned to the neighbourhood of subfamily Lymantrinae.

Genus *Calliteara* is generally with short antennae. Legs are relatively long, thus forewings are separated from each other. Cremaster is relatively slender and smooth or weakly furrowed, often with secondarily setae.

Species *Calliteara fortunata* differs by groups of scales on dorsum of abdominal seg-

ments 1-3 (thereby remains of genus *Orgyia*) and by antennae of male (these ones wide, concealed by each other). It also has more slender cremaster without secondarily setae. Otherwise it is similar to genus *Calliteara*. Scales on dorsum of basal abdominal segments occur also on additional two genera, mainly with genus *Orgyia* and *C. fortunata* probably represents some transition to this genus. It may be classified as separated subgenus.

Species *C. fascelina* used to be classified to separate genus *Dicallomera* BUTLER 1881 (e.g. in KARSHOLT & RAZOWSKI 1996, LERAUT 1997), but it is more similar to other western Palaearctic species of genus – *C. pudibunda* and *C. abietis* – from the point of view of pupal morphology than to *C. fortunata*. Thus latter species would be classified in separate subgenus (*Dicallomera*) of this genus.

Genus *Gynaephora* differs from genus *Calliteara* by wide and rounded cremaster at the end and longer antennae. It is similar to genus *Laelia* by a shape of cremaster.

Genus *Orgyia* differs from genus *Calliteara*, except of scales on the base of abdomen also by shorter legs, thus forewings are separated from each other. Female of *O. antiqua* has very large ends of metathoracic legs however, thus these ones conceal ends of mesothoracic legs and join ends of prothoracic ones. Hence, forewings are separated there.

Species *Orgyia antiqua* is separated to independent genus or subgenus *Clethrogyna* RAMBUR 1866, syn. *Teia* auctorum sometimes. From the point of view of pupal morphology this separation does not seem meaningful. It may be more acceptable to form four subgenera, the first for *O. recens* (pupa with clubbed scales on abdominal segments 1-3), the second for *O. aurolimbata* (pupa with clubbed scales on abdominal segments 1-4), the third one for *O. antiqua* and *O. antiquoides* (pupae with circled scales on abdominal segments 1-3), and the fourth for *O. chrysotephras* and *O. dubia* (pupae with circled scales on abdominal segments 1-4).

Genus *Laelia* differs from previous species mainly by secondarily setae on clypeus, both sexes have long labium and maxillae the same in length, which are approximately the same in length as prothoracic coxae, male has long antennae (their ends conceal to each other) and female has antennae medium in length separated from each other. These ones conspicuously extend beyond prothoracic coxae. Forewings are separated from each other. This genus has, similarly as genus *Orgyia* also groups of scales on basal abdominal segments 1-3 which have clubbed shape and are weaker developed on female. Cremaster is short and wide, tapering with long secondarily setae on sides. It resembles cremaster of genus *Gynaephora*. Genus *Laelia* differs from it mainly by long labium.

Larvae of genera *Calliteara*, *Gynaephora*, *Orgyia* and also *Laelia* are similar to each other in shape, mainly by typical groups of setae on dorsum, eventually on sides, resembling brushes. These genera would form the second tribe Orgyini into subfamily Orgyinae from the point of pupal morphology.

Genus *Euproctis* is characterised by short secondarily setae positioned to isolated tiny brushes on position of larval verrucae. Also their larvae are typical. From the view of pupal morphology they may form the third tribe of subfamily Orgyinae or remain in separate subfamily Nygmiinae.

Authors are aware that the system of some insect group it is not possible to classify only on the base of pupal morphology and with using only species from one zoogeographical

region. We would like to suggest some ideas for taxonomists specific to lymantriids that in current system there some taxa are not correctly positioned from the view of pupal morphology.

Similarly like in family Lasiocampidae, lymantriids are relatively poorly represented in western Palaearctic. All taxa of Lymantriidae examined by us up to now, it is quite easy to describe and identify according the pupae, because they represent very distinctive taxa. Closer taxonomical relationships would be more easily observed in fauna of regions where this family is represented by manifold species (eastern Palaearctic).

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Zusammenfassung

Die Arbeit behandelt die Puppen einiger westpaläarktischer Lymantriiden-Arten (Lepidoptera, Noctuoidea, Lymantriidae). Die Beschreibung der Vertreter von 3 Unterfamilien und Tribus, 5 Gattungen und 9 Arten und die Strichzeichnungen ihrer wichtigsten morphologischen Merkmale werden wiedergegeben. Auch werden die vorherigen Beschreibungen anhand des neu erhaltenen Materiales ergänzt und berichtigt. Die Stellung der erwähnten Arten in dem derzeitigen System wird vom Gesichtspunkte der Morphologie der Puppen diskutiert.

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Authors address:

Assoc. Prof., RNDr. Jan PATOČKA Dr. Sc.

Institute of Forest Ecology of Slovak Academy of Sciences

Stúrova 2, SK 96053 Zvolen, Slovakia

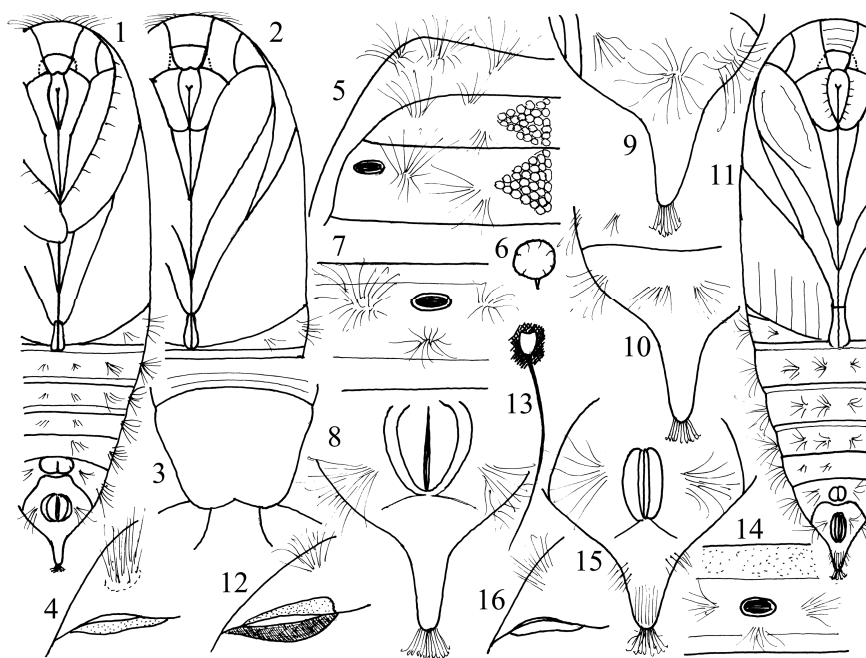
E-mail: patocka@sav.savzv.sk

Assoc. Prof., Ing. Marek TURČÁNI, Ph.D.

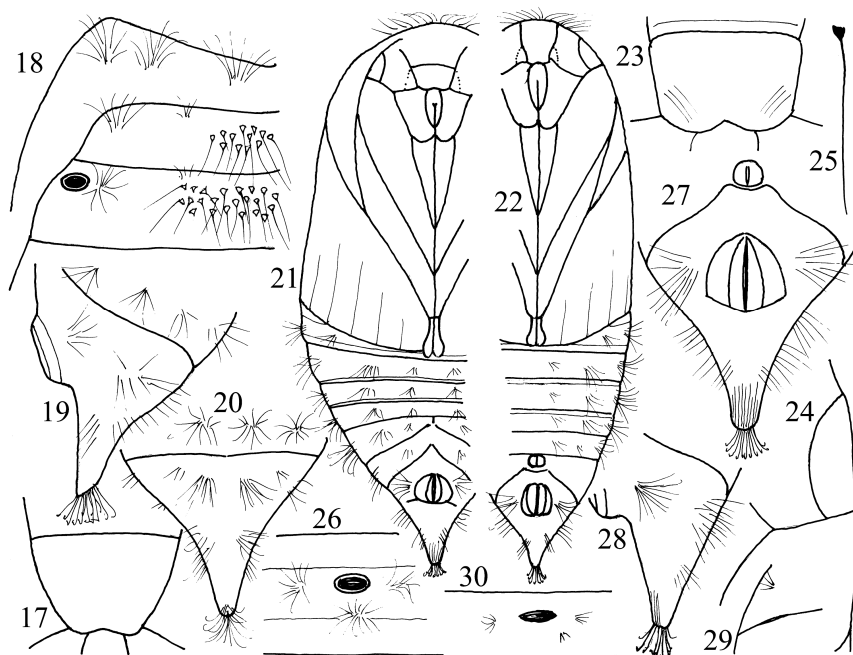
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CZ-165 21 Praha 6 – Suchbát, Czech Republic

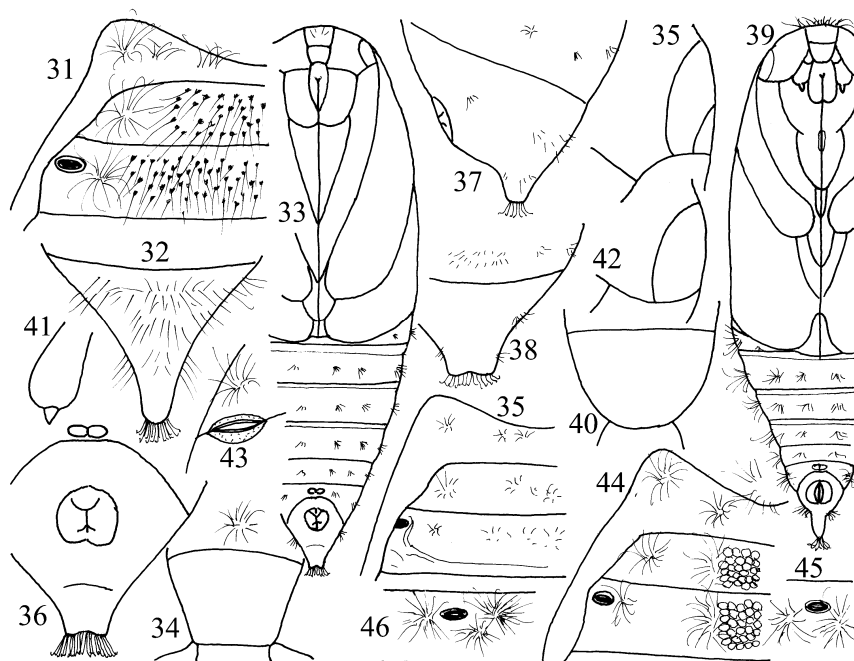
E-mail: turceni@fld.czu.cz



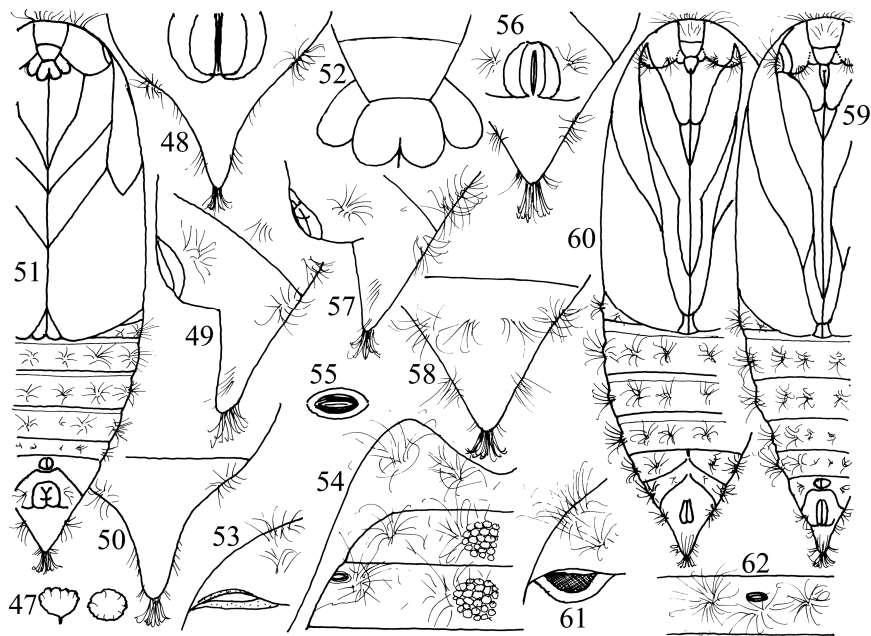
Figs 1-16: (1-10) *Calliteara fortunata*; (11-15) *C. abietis*; (16) *C. pudibunda*. (1, 2, 11) pupa ventrally (1, 11 = ♂, 2 = anterior part of pupa, ♀); (3) labrum and vicinity; (4, 12, 16) thoracic spiracle and vicinity; (5) metanotum, base of abdomen, left side; (6) a scale from the base of abdomen; (7, 14) spiracle on abdominal segment 5 and vicinity; (8, 15) end of abdomen, ventrally; (9) laterally; (10) dorsally; (13) seta from dorsum of anterior abdominal segments.



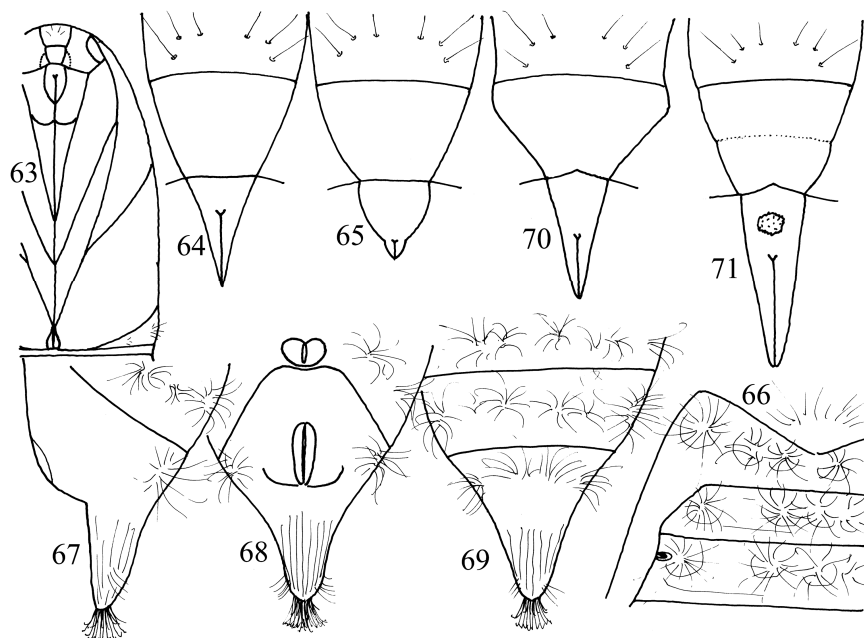
Figs 17-30: (17-20) *Calliteara abietis*; (21-28) *C. pudibunda*; (29-30) *Euproctis melania*. (17, 23) labrum and vicinity; (18) metanotum, base of abdomen, left side; (19, 28) end of abdomen, laterally; (20) dorsally; (21, 22) pupa ventrally (21= ♀, 22 = ♂); (24) oculus and vicinity; (25) seta from dorsum of anterior abdominal segments; (26, 30) spiracle on abdominal segment 5 and vicinity; (27) end of abdomen, ventrally; (29) thoracic spiracle and vicinity.



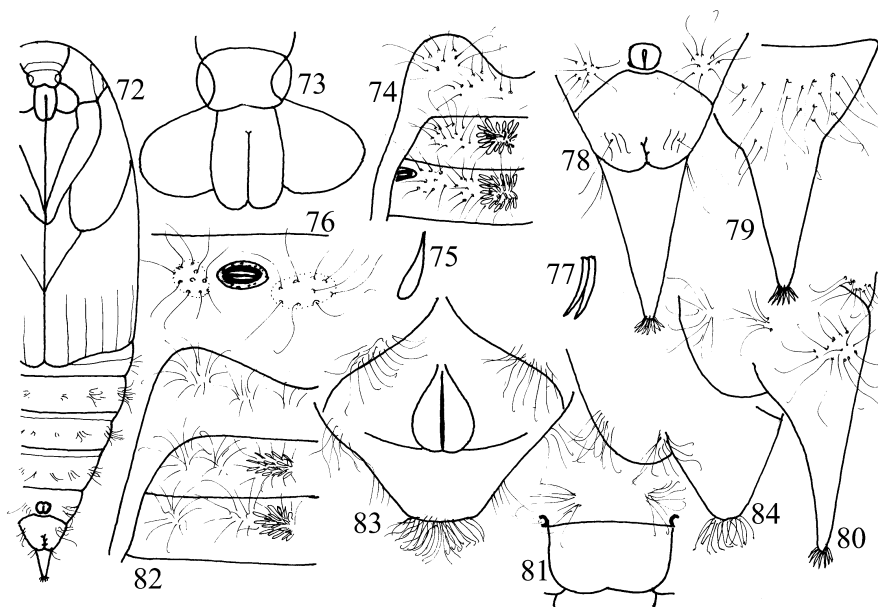
Figs 31-46: (31-32) *Calliteara pudibunda*; (33-38) *Euproctis melania*; (39-45) *Orgyia trigotephras*; (46) *O. dubia*; (31, 39, 44) metanotum, base of abdomen, left side; (32, 38) end of abdomen, dorsally; (33, 39) pupa ventrally (σ); (34, 40) labrum and vicinity; (35, 42) oculus and vicinity; (36) end of abdomen, ventrally; (37) laterally; (41) maxillae; (43) thoracic spiracle and vicinity; (45, 46) spiracle on abdominal segment 5 and vicinity.



Figs 47-62: (47-50) *Orgyia trigotephras*; (51-58) *O. dubia*; (59-62) *Ocneria terebinthi*. (47) a scale of dorsum base of abdomen; (48, 56) end of abdomen, ventrally; (49, 57) laterally; (50, 58) dorsally; (51, 59, 60) pupa ventrally (51, 59 = ♂, 60 = ♀); (52) labrum and vicinity; (53, 61) thoracic spiracle and vicinity; (54) metanotum, base of abdomen, left side; (55) abdominal spiracle; (62) spiracle on abdominal segment 5 and vicinity.



Figs 63-71: (63) *Euproctis melania*; (64-69) *Ocneria terebinthi*; (70-71) *O. detrita*. (63) pupa ventrally, anterior part of pupa (♀); (64, 65, 70, 71) labrum and vicinity (64, 70 = ♂, 65, 71 = ♀; (66) metanotum, base of abdomen, left side; (67) end of abdomen, laterally; (68) ventrally; (69) dorsally.



Figs 72-84: (72-80) *Orgyia aurolimbata*; (81-84) *Laelia coenosa*. (72) pupa ventrally; (73, 81) labrum and vicinity (73 = ♂, 81 = ♀); (74, 82) metanotum, base of abdomen, left side (♂); (75) scale of dorsum of abdominal segment 1; (76) thoracic spiracle and vicinity; (77) scales from end of cremaster; (78, 83) end of abdomen ventrally (79 = ♂, 84 = ♀); (79) dorsally; (80, 84) laterally (80 = ♂, 84 = ♀).